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Land Use and Land Cover Changes and Its Socio-Economic Impact on Local Community in Bako Tibe District, West Shewa Zone of Oromia National Regional State, Ethiopia

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Abstract
The trend of LULC changes, drivers and impacts were investigated in West Shoa Zone BakoTibe district, Oromia Regional state of Ethiopia, between 1973 and 2006 using GIS and RS, in conjunction with PRA. Three satellite images were acquired and the results showed a continuous increase in the areas of cultivated land in both study periods while decrease in forest and shrub land. Cultivated land accounts 40.4%, 46.9% and 55.0% in the years of 1973, 1986 and 2006 respectively. Cultivated land increase at an annual rate of 1.23% in the period 1973-1986 and at 0.86% in the period 1986-2006. However, forest land was diminishing from its 8.1% original coverage to 6.1% in the whole study period. Shrub land area was also reduced from 21.4% to 16.2%. Grassland was increase in the first period at the rate of 1.19% per annual and decrease in the second period at the rate of 0.62%. Also settlement continuously expands in both study periods. The major driver of land use and land cover is the population pressure. The main livelihood of the community is mainly based on agriculture, farmers expand their farm land to get subsistence food and destruct shrubs/forest for fuel wood. Lacks of clear property right on communal land also contributed for shrinkage of natural vegetation. The destruction of natural vegetation forced the farmers to change the sources of animal feed and energy sources. They used crop residue as animal feed and energy sources. In turn the mining of such organic matter from the farm land causes land degradation and reduction in crop productivity. Therefore, LULC expose farmers to extra cost to buy industrial fertilizers to get the required crop production. Also farmers recently start cultivation of high value cash crop to earn more income. To reduce the negative effect of LULC, the surrounding agricultural research institutes should work more with local community by providing improved stove which is efficient in energy use and improved breed of livestock.
Keywords: Ethiopia, LULC, GIS, Remote sensing, and Socio-economic

1. INTRODUCTION

1.1 Background and Justification

Land use and land cover dynamics specifically deforestation long ago has been a global concern, with an adverse implications for human livelihood systems (Woldeamlak, 2002). Human and natural modifications of land use and land cover are the causes of environmental problems, like deforestation, biodiversity loss, global warming and increase of natural disaster-flooding and extreme temperature (Reis, 2008; Zhang *et al.*, 2008). Therefore, currently land use and land cover change is both global and political issue (Chowdhury, 2006).

From the beginning of civilization, human-beings have intentionally managed and converted the landscape to exploit natural resources mainly to derive basic needs such as food, shelter, fresh water, and pharmaceutical products (Goldewijk and Ramankutty, 2004).However, the increase in population has proportionally increased the demand for resources for centuries and leading to the conversion of natural environmental conditions (Lambin, *et al*., 2001). Ecological processes and human interventions are facilitating ecosystem changes as a whole and land cover change in particular (Manson, 2005). Negative land use and land cover change processes understood as the change from any primary dominated land cover into any man-made dominated one (Velazquez, 2003).

The local level of land use and land cover dynamics caused extended land degradation which was affecting both the security of the natural environment and people's livelihood (Efrem et al., 2010). The land use and land cover alterations, that are negatively influencing, are generally caused by mismanagement of agricultural, urban, range and forest lands (Gete and Hurni, 2001).

Identifying, delineating and mapping of the types of land use and land cover are important activities in support of sustainable natural resource management. To understand how LULC change affects and interacts with environmental systems, information is needed regarding what changes occur, where and when they occur, the trends, rates at which they occur, and the social and physical forces that drive those changes (Lambin*et al.*, 2003).

Studies of the magnitude, rates, patterns, causes, and socio-economic implications of land use and land cover dynamics at the local level can help to design more effective land management strategies and policies

(Kebrom and Hedlund, 2000). But investigations in cover dynamics at this level are not common in Ethiopia (Woldeamlak, 2002).

"Bako" agricultural research institutes are located and for a long period of time the institutes have been conducted researches commonly on crop, livestock, and farm machinery related hitherto no research have been conducted in relation to the rate, magnitude of land use and land cover change of the area and its impact. Therefore, this research was conducted to bridge the information gap on the status, causes of LULC change, and its impact on livelihood of the local community. Also the research explores how communities cope up with this environmental change. The result could provide basic information on the status of land use and land cover and on the direction of changes to help the decision makers. In addition it may serve as baseline information for the researchers who wants to conduct further research on the area.

Specific objectives:

- To determine the magnitude and rate of land use and land cover change
- To identify the causes of changes and to assess the effect of land use and land cover change on the socio-economic condition of the local communities

2. MATERIALS AND METHODS

2.1. Data acquisition for land use and land cover

Three dates periods of satellite images (1973, 1986 and 2006) of the area were acquired from Ethiopian Mapping Authority (EMA). Topographic map of 1976 of the study area with the scale of 1:50,000 was used as an aid during interpretation of the image specially for the year 1973. The necessary interviews were also conducted with elders to avoid ambiguities when previous satellites images were interpreted. The ground truth information required for the classification and accuracy assessment were collected from the field using Global Positioning System (GPS). Administration boundary of the study area was obtained from the Ethio-GIS. After the LULC units were digitized into different land cover classes by ERDAS 9.2 their dynamics in each of the study period determined using ENVI 4.7. The change matrix obtained and further processed using Microsoft excel. The changes in areas of each land use and land cover types were determined and valued in km^2 and percentage. Also the rate of change was calculated.

2.2. Data collection

To explore the causes and impacts of LULC change socio-economic surveys were conducted. For socio-economic survey among the total 28 kebeles in the study area 3 kebeles (D/Gobbu, G/Quyi and D/Dima) were randomly selected. Various data collection tools were used to collect the required information. These include different focus group discussions; Key informant interview (elder, development agents and concerned official) and formal survey were held to get brief information's.

Focus group discussions were conducted with groups of individuals and the discussions were guided by a facilitator. In each kebeles two focus group discussions (one male and one female) were conducted. A total of six group discussions were undertaken. Each group in average consists of six members.

Key informants (people who are supposed to be knowledgeable of their locality and have a good knowledge of the area) were selected with the help of DAs and kebele administrators. These informants were mainly elders and opinion makers in the community. The interview was also conducted with DAs and kebele administrators. A checklist that contains important topics was used to guide the interviews.

Formal survey was conducted based on the structured questionnaire on 5% of sample households that were selected randomly and proportionally from each kebeles. The total numbers of households for those selected three kebeles were 740, 823, and 701 respectively. Preparation of questionnaires, their translation to the local language ("Afaan Oromo"), training of data enumerators, pre-testing the questionnaire and feedback, and finally the actual field work were conducted. Furthermore, published and unpublished documents were referred to get secondary information.

2.3. Data analysis

To get meaningful information data should be properly analyzed. Different data analysis techniques were used based on the data collection techniques. Since there were qualitative and quantitative data in this study, they were analyzed differently. The qualitative data obtained through key informant interviews and focus group discussion were narrated and summarized. The quantitative data that were obtained through formal survey and image classification were analyzed by means SPSS software version 19.

3. RESULTS

Six categories of land use and land cover were identified on the image 1973 while five land use and land cover on the images of 1986 and 2006. The six major land use and land cover types identified were settlement, grass land, wet grassland, grassland, forest and cultivated land. But wet grassland not exists on the images of 1986 and

2006.

3.1. Status of land use and land cover maps of the years 1973, 1986, and 2006

In all the periods considered, cultivated land constituted the predominant type of LULC, 258.4 km^2 (40.4%), 299.8 km^2 (46.9%) and 351.6 km^2 (55.0%) in the years of 1973, 1986 and 2006 respectively (Table 1). Wet grassland which was accounted 56km^2 (8.8%) of the total study area and it only exist 1973 map.

Grassland was fluctuated and accounts 125.1 km^2 (19.6%), 144.5 km^2 (22.6%), and 126.7 km^2 (19.8%) in 1973, 1986 and 2006 respectively. Whereas, forest land was diminished from 52 km^2 (8.1%) of its original coverage to 38.7 km^2 (6.0%) during the total study period considered. Shrub land area was also reduced from 137.2 km^2 (21.4%) to 103.8 km^2 (16.2 %). Settlement was continuously increasing from 11.2 km^2 (1.8%) of the initial study period to 19.2 km^2 (3%) at the end of study period (Table 1).

Table 1 Land Use and Land Cover Categories and Their Respective Area Coverage, in Sq. Km and Percentage

LULC Types	1973		1986		2006	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Cultivated land	258.4	40.4	299.8	46.9	351.6	55
Grass land	125.1	19.6	144.5	22.6	126.7	19.8
Forest land	52.1	8.1	49.4	7.7	38.7	6.0
Shrub land	137.2	21.4	133.0	20.8	103.8	16.2
Settlement	11.2	1.8	13.3	2.1	19.2	3.0
Wet grass land	56	8.8	-	-	-	-

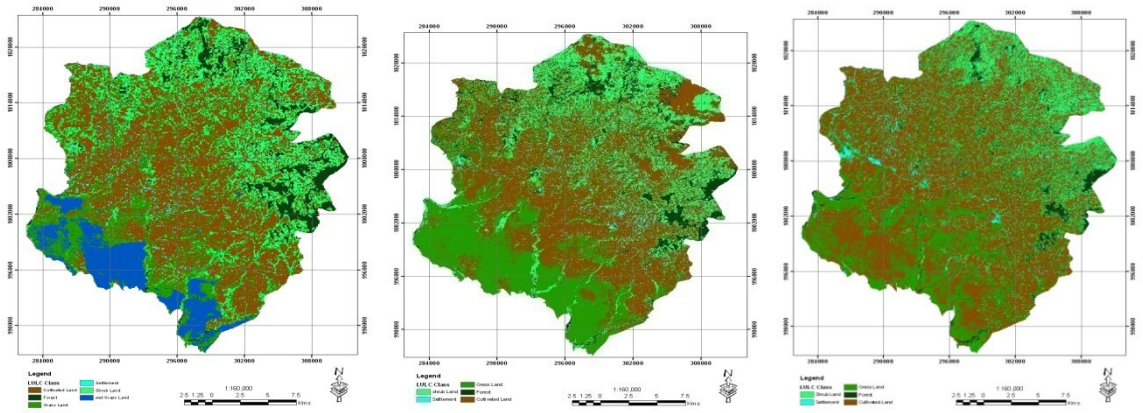

Figure 1 Land Use and Land Cover Map of 1973, 1986 and 2006

3.2. Land use and land cover dynamics and change matrix

Cultivated land was intensified in both study periods (1973-1986 and 1986-2006) by 16.0% and 17.3% of its original size respectively. In the first period, cultivated land was expanded at the rate of 1.23% and in the second period at the rate of 0.86% per annum (Table 2). The trends in grassland category were showed an increasing pattern in the first period while decreasing in the second period. So, grassland was increased by19.4km^2 (15.5%) between 1973 and 1986, and was decreased by 17.8km^2 (12.3%) between 1986 and 2006 from its original extent. Furthermore, the change detection matrix showed that in the first period of the study, 47.1 km^2 of the grassland remains unchanged, while 46.3 km^{2}and 23.1 km^2 transformed to cultivated land and shrub land respectively. Whereas, in the second study period 60.5km^2 of grass land remains unchanged but 76.7 km^{2}converted to cultivated land.

During the first study period, shrub land was declined by 4.2 km^2 (3.1%) and 29.2 km^2 (22%) in second study period. Forest land was also reduced by 2.7 km^2 (5.2%) in the first period and 21.7% in the second period (Table 2). Moreover, the computed change detection matrix in the first study period showed a conversion of 13.2 km^2 and 16.5 km^2 of forest land covers to cultivated land and shrub land respectively. By the same period, 52.7 km^2 and 17.2 km^2 shrub lands transformed to cultivated and forest land respectively. Whereas, in the second period 11.9 km^2 and 15.9 km^2 of the forest land converted to cultivated land and shrub land respectively. And also second study period 60.7 km^2 and 15.2 km^2 shrub land converted to cultivated land and grass land respectively.

Table 2.Extent and the Rate of LULC Changes in Different Periods

	1973-1986			1986-2006		
LULC Types	Change in Km2	Percent Change	Average annual change in %	Change in Km^2	Percent change	Average annual change in %
Cultivated land	41.4	16	1.23	51.8	17.3	0.86
Grassland	19.4	15.5	1.19	-17.8	-12.3	-0.62
Forest land	-2.7	-5.2	-0.4	-10.7	-21.7	-1.09
Shrub land	-4.2	-3.1	-0.24	-29.2	-22	-1.1
Settlement	2.1	18.8	1.42	5.9	44.4	2.22
Wet grassland	-56	-100	-7.69	-	-	-

3.3. The trend of vegetation cover changes and environmental degradation

The outcome of the key informant's discussions revealed that the historical forested hills in the area, which are now bare land without vegetation and according to them 30 years ago the area was covered by shrubs and trees. The elders also pointed out that the effect of this deforestation has been caused an unexpected flood and soil erosion in the area, which affects the croplands, harms their cattle and human beings and within the last 5 years a number of recorded incidents were increased, two individuals and 15 livestock have been died due to this unexpected flood near to the hill. All the interviewed farmers were understood that the unexpected erosion and land degradation related with forest degradation and deforestation. The elders clearly indicated the environmental implication of vegetation removal incidences especially from the nearby hill area since 1991 the onset of rainy season in the area has been delaying and temperature of the area is increased. Discussions also disclosed that threatened of some important native tree species like *Prunes african*, *Podocarpus falcatus* and *Cordia africana,* which were used for house construction. As a result, to cope with the demand of wood for different purposes, an exotic species like *Eucalyptus, Gravella robust, Cupress lustanica* replacing the indigenous ones through woodlot establishment around their homestead. Moreover, in the area, due to deforestation there was also a shift in household energy use from fuel wood to crop residue, cow dung and eucalyptus plantation. Historically, before 20 years ago, 95% of the households use natural forest and shrub land for the households' energy but currently only 20% households has access of fuel wood collection for cooking and heating from the natural forest and shrub land. While, the remaining 45% obtained from eucalyptus woodlots, and 35% of the households use animal dung and crop residue as primary energy sources.

According to a woman who explained during focus group discussion, previously when the women collect fuel wood from the natural forest, during collections they also took chances for social interaction and informally communicate with fiends and discuss about their social issues. But now due to deforestation they lost such communication and they consider this as a disadvantage circumstances. The nearby water sources have been dried and women are obliged to travel long distances to fetch water for the household consumption and the interview link up the drying of small brooks and springs with climate fluctuation. Nowadays, male farmers move their livestock long distance to get water point for drinking.

. It was encouraging that in the area farmers highly motivated on conserve and tends the scattered trees on their crop lands and enriching the mountains patched forests. One good thing presently observed in the area was that farmers are prohibited from cutting trees from anywhere including their own crop lands without the permission of the concerned development agent and chair person of the kebeles. As the elders believed that trees on farm land has been increasing in recent time because of the awareness created by the concerned body and the restriction of cutting trees from crop lands.

3.4. Causes of land use and land cover change

The analysis of the satellite images and ground survey were revealed that cropland expansion was one of the major causes of forest degradation, deforestation and reduction of the area of grass lands. Supporting the mentioned main cause, about 70% of the sampled households were believed that the primary driving force of the land use and land cover change in the study area was cropland expansion which is the bases for the survival of farmers while 30% of the households were considered the lack of clear land property right and institution on forest resources and grassing land cover.

According to results from the focus group discussions, lack of clear property right on forest and grassing land causes over exploitation and miss use of those open communal lands. As the information from agricultural office showed that the establishments of resettlement during the "Derg" regime in the area mainly contribute for deforestation and disappearance of grassland. Elders also gave their witnesses on the important driving forces of the LULC change; especially small wetlands were converted to other LULC without considering their ecological importance because of lack of awareness from the farmers' side. These lands have been used for vegetables cultivation and for intensive grassing during the dry season. Farmers consider wetlands as waste land and they believed that their existence in the area was a symbol of an evil spirit.

In addition, the expansion of the towns towards the study kebeles also a cause to convert forest lands to cultivation and settlements. During this study, it was observed that there is a big agricultural project established by Indian investor called "Karaturi", converts vast area of shrub and grasslands to commercial agriculture in the lowland part of the district.

4. DISCUSSION

The land use and land cover findings disclosed that cultivated land account the major proportion in all study periods. This domination of the cultivated land clearly confirms the livelihood of the people in the study area is primarily depending on annual crop production. The trend of change in cultivated land shows increment in both period at the rates of 1.23% and 0.86%per year. Study conducted in dried lake Haramaya lake watershed by Mohammed (2011) also shows dominance of cultivated land over the other land use and land cover types. The results in the expansion of cultivated land is in line with Gete`s (1997) report, land use and land cover of this category expanded by 39.4 % in the period between 1957-1982 in Dembecha area of Gojam Zone, Ethiopia. In contrast, the magnitude of changes in the expansion of cultivated lands is far from the findings that have been reported by Belay (2002), 0.24% between 1957 and 1986 and 0.1% between1986 and 2000 in "Derekolli" catchment.

The expansion of cultivated land was at the expense of grassland, shrub land and forest land in both the first period and second periods. The present study showed that there was a rapid LULC change over the whole study period with cultivated land replacing shrub land and grassland. Such trends are similar with other study conducted in Ethiopia (Gete & Hurni, 2001; Gessessie & Christiansson, 2008; Efrem, 2009).

Forest land accounts 8.1%, 7.7%, and 6.1% in 1973, 1986 and 2006 respectively, whereas shrub land accounts 21.4%,19.8% and 16.2%. Accordingly, both lands are subjected to a destructive change in both study periods. In the first period, the annual rate of changes was estimated to be -0.4% for shrub land and -0.24% for forest land. On the other hand, in the second study period, the rates of changes were intensive and estimated to be -1.0% for forest land and -1.1% for shrub land. The rate of changes is greater in the second period for both shrub and forest land. The current study is in agreement with the study reported by Kebrom and Hedlund (2000) forest and shrub lands have been decreased at a rate of -1.1% and -1.8% in Kalu district, South Wello. In contrast to our findings, a report revealed an improvement in forest and shrub land use and land covers in the Semen Mountain National Park of Ethiopia (Menale*et al.*, 2011).

As clearly observed from the map of the 1973, grassland and wet grassland were mostly concentrated in the southern part of the district. The changes in grassland category were showed an increasing pattern in the first period while decreasing in the second period. So, grassland was increased by 15.5% between 1973 and 1986, and was decreased by 12.3% between 1986 and 2006 from its original extent. This shows that grassland was expanded at a rate of 1.2% in the first period while shrunk at a rate of 0.71% in the second period. The increment of grassland in the first period was in the expense of wet grassland while its diminishing trend in the second period was due to the expansion of cultivated land. Furthermore, the change detection matrix showed that in the first period of the study, 37.6% of the grassland remains unchanged, and 37% and 18.4% transformed to cultivated land and shrub land respectively. Whereas, in the second study period 41% remains unchanged and 53% converted to cultivated land.

Settlement covers from the total area 1.8%, 2.1%, and 3% consecutively during the study years. Area covered by settlement continuously increased throughout the study period. This expansion of settlement argue that the population of the study area increasing. But the present distribution of settlement was not evenly distrusted more concentrated on the high land part of the study area.

4.1 Causes and consequences of LULC

The present study revealed that the productivity of the crop land has been declining overtime. According to farmers, the declining of crop productivity had contributed to the expansion of farm lands to compensate the loss of crop productions from the extended crop land area. Farmers also believed that the declining crop productivity was aggravating due to soil degradation caused by the destruction of forest and shrub land.

Other important factors for the decline of forest and shrub land and the expansion of cropland were the rapidly increasing population pressure, and the data witnessed that during the past 20 years population is increased by 68.3%. The main source of fuel wood in the area was trees/shrubs and farmers' livelihood is based on agricultural activities. Hence, fuel wood consumption and looking for more cultivated land due to the growth of population leads destruction of natural vegetation. Different research findings (e.g., Jorgenson and Burns, 2007; Efrem*et al.*, 2009) show population pressure is the major driver of LULC specifically on negative conversion of natural vegetation where agriculture is the main livelihood option and also causes land degradation. The same holds true for the study area where there was showing increased population number and agriculture is the main livelihood option.

Shrinkage and degradation of grassland forces farmers to search other strategies to feed their livestock.

Among the strategies is storing of crop residue. Removal of crop residue to feed animals has consequences that bring land degradation of cultivated land by reducing organic matter content of the soil. In the other development, the decline of the number of livestock in the area, this may be a consequence of these factors.

Due to the destruction of forest and shrub land which were previously the source of energy for cooking and heating in the households' that converts the strategies of households' to plant trees as small woodlot and use animal manure and crop residue. In "Bako" town, rural technology research center is introducing the improved stove and distribute to the customers. However, the survey result shows that no farmers are using those stoves. Farmers are forwarded that the cost of these improved stoves is not affordable and instead they continue to use the traditional one. Personal communication revealed that only people those who live in towns use this improved stove.

Those forests and grassland areas were considered as open and common properties and farmers always compute and mine to maximize their benefit from them instead of managing and conserving in the sustainable manner. Property right especially on communal lands including forest has not been clear and their protection were not materialized instead these resources were exposed to degradation.

Previously farmer's use "Chichata"[1] to fertilize their farm land by constructing rotational house for livestock on crop lands during the dry season of the year and later cultivate these lands in summer. But due to the decline of the number of livestock associated with the diminishing of grass land in the area, such practices were rarely observed now. Also farmers previously practice fallowing their crop land to renovate them in terms of nutrient addition but recently this practice is outdated due to shortage of crop land in the area. However, to compensate the required crop products farmers utilize more dosage of artificial fertilizers than the previous amount. As the respondents pointed out, the dose of artificial fertilizer increases from year to year. This indirectly indicates how much the productivity of the land decline.

Some farmers recently transforming the traditional farming system to high market value cash crop based. They produce vegetable where small streams exist. In turn, cultivation of those important wet lands may cause the destruction of important vegetation like, grass and riverbank shrubs. The expansion of small scale irrigation on farm land using pump also observed as a new practices to cultivate pepper, tomato, sugarcane, and onions. As the farmers reported the distribution of water pumps were from the bureau of agriculture by arranging some microfinance without paying taxes. The above practices showed how farmers adjust themselves with the changing environment and market conditions.

In Ethiopia, now a day the policy would favor agricultural investment. As mentioned, in the study area a big project is commenced to produce palm oil and hopefully the project could create job to the landless youngsters and may bring foreign currency for our country. However, such huge mono-cropping commercial agriculture could affect the indigenous diverse species both fauna and flora. Generally it is obvious that development comes with environmental and social cost but needs to make balance and minimize environmental and social consequences. Therefore, existing agricultural policy might indirectly contribute the land use and land cover change in the study area.

Further, farmers promised to practice natural resource conservation especially involving on watershed development in the region and particularly in the study district. It was encouraging that farmers already involving on conservation, tending scattered trees on crop land and enriching the mountains with plantation forests. As mentioned earlier farmers are not harvesting trees from anywhere including their own crop land without permission. As the elders previous mentioned, trees on farm land has increasing in recent time because of the awareness created by concerned body and the restriction of cutting tree practices.

5. CONCLUSION AND RECOMMENDATION

Satellite image analysis showed the area has undergone a dynamic land use and land cover changes in both study periods. The trend show that natural vegetations (shrubs and forest) where declining in both period. Grassland increases in the first period by 15.5% at the expense of wet grassland and diminished in the second period by 12.3%. Forest and shrub decline in the first period by 5.2% and 3.2% of their original cover respectively. Also they continue shrinkage in the second period by 21.7% and 22% respectively. Cultivated land expands in both periods by 16% and 17.3%. The destruction of the shrub and forest land in the area was mainly due to expansion of agriculture and fuel wood energy demand. Wet grassland which was constituted 8.8% of the total area in 1973 has been lost during the years of 1986 and 2006 maps.

Farmers have good knowledge to the environmental services that forest and shrubs lands are providing but to coping with the pressure from the growth of population for subsistence those areas are converted to crop lands. The productivity of these lands was decreasing due to the continuous cultivation without any input like fallowing and traditional practice "chichata" to improve soil fertility. In the study are irrigation practices are observed and farmers produce high value cash crop this is one of the positive direction that farmers are reacting. The

[1] Fertilizing crop land by manure

preference of farmers on crop types also changed based on the access, environmental and economic conditions.

On the other hand, the number of livestock ownership by households is declining when compared to previous years. The main reasons are that the decline of sizes and the degradation of grassing lands to produce adequate feed to livestock.

In the area, agricultural investment policy is allowed for conversion of lands to commercial agricultural land, it has seen as one of the environmental challenge in the study area. The settlements during Derg regime also significantly affect forest and shrub cover of the study area. Due to deforestation of natural forests farmers' responded in such away to establish plantation of eucalyptus as homestead woodlot to compensate the demand of construction and fuel wood products.

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